

U.S. Serial Number: 10/699,232  
Reply to Office Action of: 06/23/05  
Family Number: P2001J013-US2

Page 2 of 7

### AMENDMENTS TO THE CLAIMS

1. (currently amended) A method comprising disaggregating asphaltenes in a petroleum oil and mixtures of petroleum oils, feedstream and/or refinery process streams by mild heating of said petroleum oils and mixtures of petroleum oils, feedstream and/or refinery process streams, the disaggregated asphaltenes remaining soluble in the petroleum oil and mixtures of petroleum oils feedstream and/or refinery process streams wherein said heating is performed at a temperature between 40°C and 150°C 60°C for a time period of ± 4 minutes to ~~four weeks~~ 1 hour.
2. (previously presented) The method of claim 1 further comprising the step of determining the presence of asphaltene aggregates by irradiating said petroleum oils and oil mixtures of petroleum oils, feedstream and/or refinery process streams with neutrons and determining small angle neutron scattering (SANS) intensity,  $I$ , as a function of wavenumber,  $q$ , wherein said scattering intensity includes a coherent component and an incoherent component.
3. (previously presented) The method of claim 2 wherein said neutron scattering wavenumber,  $q$ , is in the range  $10^{-4} \text{ \AA}^{-1} \leq q \leq 1 \text{ \AA}^{-1}$ .
4. (previously presented) The method of claim 3 wherein compatibility and incompatibility of petroleum oils and mixtures of petroleum oils and/or refinery process streams are determined fitting  $I(q)$  to an equation based on a physical model that contains coherent components, a strongly decaying component to describe the surface scattering of asphaltene aggregates at the  $q$  near its lower range (low- $q$ ), a plateau component with a falloff for  $q$  near its upper range (high- $q$ ) to describe the asphaltene particles, and a constant to describe the  $q$  incoherent component.
5. (previously presented) The method of claim 4 wherein the equation is given by

U.S. Serial Number: 10/699,232  
 Reply to Office Action of: 06/23/05  
 Family Number: P2001J013-US2

Page 3 of 7

$$I(q) = I_{\text{incoh}} + I_L / (1 + q^2 \xi^2) + I_{\text{surf}} (q / q_1)^{-\alpha}$$

Wherein,  $I_{\text{incoh}}$  is the constant high- $q$  incoherent scattered neutron intensity,  $I_L$  is the low- $q$  plateau intensity of the Lorentzian (second term),  $\xi$  is the correlation length (proportional to the radius of gyration of an asphaltene particle),  $I_{\text{surf}}$  is the low- $q$  value of the intensity due to surface scattering from asphaltene aggregates,  $\alpha$  is the absolute value of the logarithmic slope of  $I(q)$  at low  $q$ , and  $q_1$  is fixed by the lowest  $q$  in the range.

6. (previously presented) The method of claim 5 wherein incompatibility is determined by the concavity of the low- $q$  plateau intensity of the asphaltene particles,  $I_L$ , as a function of the volume fraction of mixing,  $\phi_m$ .

7. (previously presented) The method of claim 5 wherein incompatibility is determined by the systematic deviation of  $I_L$ , as a function of mixing volume fraction from a hard sphere prediction.

8. (previously presented) The method of claim 5 wherein incompatibility is determined by a maximum in the correlation length,  $\xi$ .

9. (previously presented) The method of claim 5 wherein incompatibility is determined by the dominance of the low- $q$  value of the surface scattering intensity,  $I_{\text{surf}}$ , over the sum of the low- $q$  plateau intensity of the asphaltene particles,  $I_L$ , and the incoherent scattering intensity,  $I_{\text{incoh}}$ .

10. (previously presented) The method of claim 5 wherein incompatibility is determined by the power law exponent,  $\alpha$ , exceeding a value of three.

U.S. Serial Number: 10/699,232  
Reply to Office Action of: 06/23/05  
Family Number: P2001J013-US2

Page 4 of 7

11. (previously presented) A method to estimate the volume fraction of asphaltene aggregates,  $\phi_{agg}$ , in incompatible petroleum oil and/or refinery process stream mixtures comprising determining the difference between  $I_L$ , the low- $q$  plateau intensity corresponding to the asphaltene particles and  $I_{HS}$ , the intensity perfect hard spheres in the absence of aggregation, wherein  $I_L$  and  $I_{HS}$  are determined at different volume fractions of mixing  $\phi_m$ .

12. (previously presented) The method of claim 11 wherein the equation to estimate the volume fraction of asphaltene aggregates,  $\phi_{agg}$ , is given by the difference between the measured value of  $I_L(\phi_m)$  and the  $I_L(\phi_m)$  for perfect hard spheres in the absence of aggregation.

13. (previously presented) The method of claim 5 wherein the total surface area of asphaltene aggregates per unit volume of the petroleum oil,  $S_v$ , is determined from the surface scattering intensity,  $I_{surf}$ , at low wavenumbers,  $q$ .

14. (previously presented) The method of claim 12 wherein the average length scale,  $R$ , associated with the internal structures of the asphaltene aggregates is determined from the ratio of the volume fraction of asphaltene aggregates and the total surface area of asphaltene aggregates, wherein the total surface of asphaltene aggregates per unit volume of the petroleum oil,  $S_v$ , is determined from the surface scattering intensity,  $I_{surf}$  at low wavenumbers,  $q$ .

15. (previously presented) The method of claim 2 wherein said neutron scattering wavenumber,  $q$ , is in the range  $10^{-3} \text{ \AA}^{-1} \leq q \leq 10^{-1} \text{ \AA}^{-1}$ .

16. (cancelled)

17. (cancelled)

U.S. Serial Number: 10/699,232  
Reply to Office Action of: 06/23/05  
Family Number: P2001J013-US2

Page 5 of 7

18. (cancelled)

19. (cancelled)